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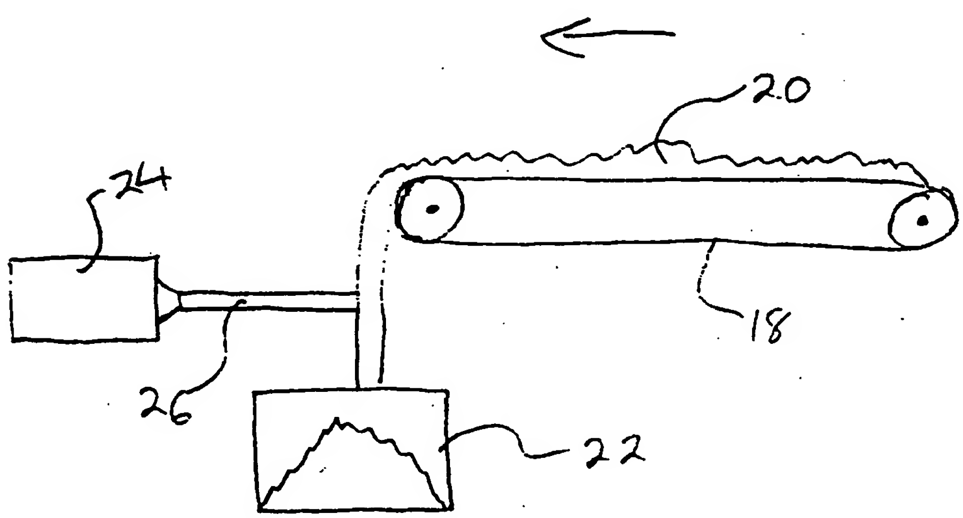
(54) **PROCEDES METALLURGIQUES UTILISANT LES CHOCS THERMIQUES AUX MICRO-ONDES**

(54) **MICROWAVE THERMAL SHOCK METALLURGY**




(57) A method to enhance the extraction of an element from an ore by subjecting the element bearing material to a thermal shock. The thermal shock is sufficient to cause microfracturing of the material without significant change in the chemical structure, thereby reducing or essentially eliminating the refractory nature of the ore. The microfractured material may then be processed in a conventional manner at a relatively higher yield, than would otherwise be the case.

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## ABSTRACT

A method to enhance the extraction of an element from an ore by subjecting the element bearing material to a thermal shock. The thermal shock is sufficient to cause microfracturing of the material without significant change in the chemical structure, thereby reducing or essentially eliminating the refractory nature of the ore. The microfractured material may then be processed in a conventional manner at a relatively higher yield, than would otherwise be the case.

# Microwave Thermal Shock Metallurgy

The present invention relates to the extraction of base and precious elements from ores.

## BACKGROUND OF THE INVENTION

It is well known that an elemental material may be extracted from an ore using various chemical processes. Element bearing ores are mined, refined and the element extracted through well established processes that utilize a number of different physical and chemical properties of the ore and the element.

In some circumstances, the ore may contain significant quantities of the element to be extracted, which cannot be performed with a conventional extraction process. In other cases, the extraction process is capable of extracting the base element, although the structure or physical characteristics of the ore inhibit that process and therefore the effective yield is significantly reduced.

It is therefore an object of the present invention to provide a process and apparatus which obviates and mitigates the above-disadvantages.

## SUMMARY OF THE INVENTION

In general terms the present invention seeks to enhance the extraction of the element from the ore by subjecting the element bearing material to a thermal shock. The thermal shock is sufficient to cause microfracturing of the material without significant change in the chemical structure, thereby reducing or essentially eliminating the refractory nature of the ore. The microfractured material may then be processed in a conventional manner at a relatively higher yield, than would otherwise be the case.

Preferably the thermal shock is provided by microwave energy delivered over a period of time sufficient to cause a heating effect but insufficient to initiate chemical change.

## BRIEF DESCRIPTION OF THE DRAWINGS

An embodiment of the invention will now be described by way of example only with reference to the accompanying drawings in which:

**Figure 1** is a process flow sheet showing the processing of ore.

**Figure 2** is a schematic of apparatus used in the process shown in Figure 1.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring therefore to the process in Figure 1, ore is initially mined and crushed to a uniform size as shown at 10. It can then be concentrated at 12 using well known concentration techniques such as froth flotation and the concentrated ore passed to a decrepitation device indicated at 14. After decrepitation the ore or concentrate, otherwise known as feed, is passed to an extraction stage 16, where it is processed in one of an number of conventional ways to extract the required elements.

The decrepitation stage 14 is shown in further detail in Figure 2. Decrepitation is a process by which a mineral microfractures due to a rapid expansion of a material, such as in fluid inclusions contained in the mineral.

An endless belt 18 receives the feed indicated at 20 and deposits it in a hopper 22 that is vertically spaced below the belt 18. As the feed 20 falls in a uniform curtain from the belt 20 to the hopper 22 it passes a microwave generator 24. The generator 24 provides a beam of microwave energy 26 that impinges upon the feed 20.

The beam 26 is chosen to impart sufficient energy to the feed 20 to induce decrepitation without significantly changing the chemical composition of the feed 20.

Typically the microwave source 24 will have a power output of less than 50,000 Watts and the beam will be distributed over an approximate area of 100 square inches. The exposure of the feed 20 to the microwave beam 26 will be less than one second and preferably in the order of one tenth of a second. The combination of beam duration and intensity act to create a thermal shock in minerals receptive to microwave energy 26.

The exposure to microwave energy 26 is determined such that it is sufficient to heat the feed 20 to provide a plurality of microfractures in the encapsulating mineralization of the feed 20 but not sufficient to heat the feed 20 of a sufficient duration to induce chemical change. By inducing the microfracturing, the susceptibility of the ore 20 to subsequent extraction is enhanced resulting in a greater yield.

If necessary, an inert atmosphere may be utilized around the feed 20 to inhibit oxidation or chemical change during the exposure to the microwave energy 26. Typically the process may be used in the extraction of a wide variety of elements including for example gold. In the case of gold, the microfracturing would permit access of a cyanide solution in subsequent processing to the previously sequestered grains of gold and thereby enhance the yield from the feed 20. It will

be appreciated that other ores may be processed including metal bearing ores and non-metal bearing ores.

In addition to decrepitation, other physical phenomena inherent in natural ores will lend themselves to microfracturing under microwave induced thermal shock, which may contribute in combination with the fluid inclusions to the overall comminution of the ore. The phenomena may include but are not limited to variation in each coefficient of thermal expansion among minerals and along their crystalline axes (anisotropy), variation in a crystalline inhomogeneity within individual minerals and between different minerals, imperfections in the minerals, a presence of non-crystalline or only immature crystalline minerals such as glass, compositional zoning and hence the coefficient of expansion within individual minerals, and variation in a thermal inertia between a plurality of minerals.

Although the invention has been described with reference to certain specific embodiments, various modifications thereof will be apparent to those skilled in the art without departing from the spirit and scope of the invention as outlined in the claims appended hereto.

**THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:**

1. A method of enhancing an extraction of an element from an ore including the steps of:
   a) subjecting the element bearing material to a thermal shock to cause microfracturing of said material without inducing a significant change in a chemical structure of said material and
   b) processing of the microfractured material to extract said element from said material.
2. The method of claim 1, wherein said thermal shock is provided by microwave energy delivered over a period of time sufficient to cause a heating effect of said material but insufficient to initiate a significant chemical change of said material.

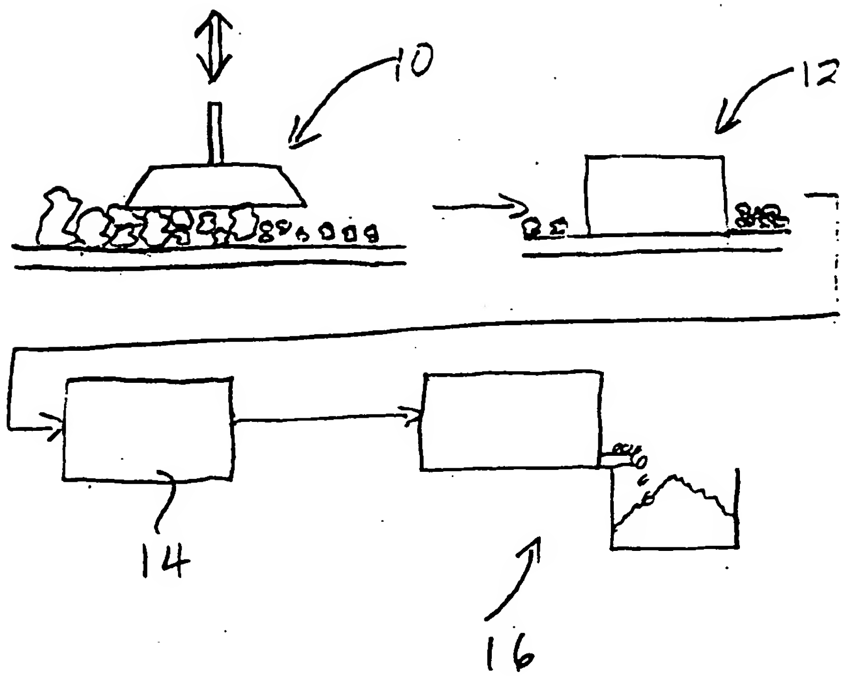


Fig 1

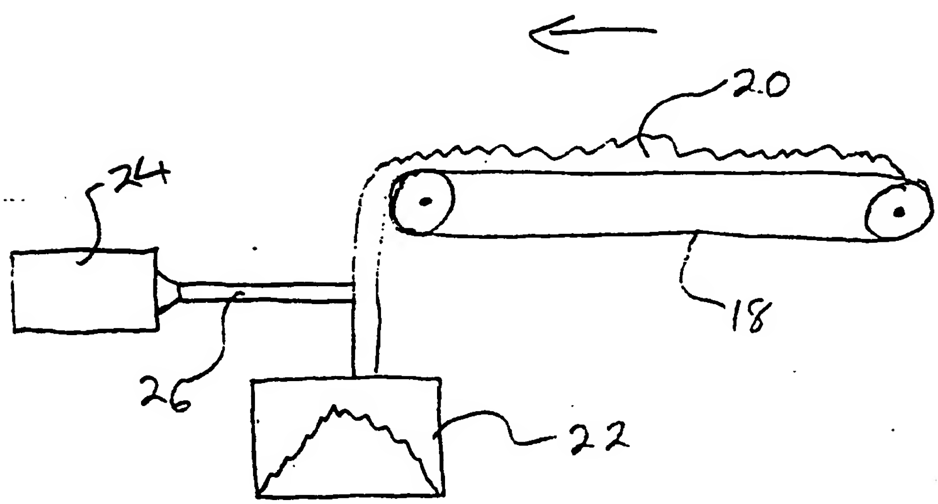


Fig. 2